CLAIMS

1. Method for the decoding of a received signal comprising symbols distributed in space, time and/or frequency by means of a space-time or space-frequency encoding matrix,

characterized in that the method implements a space-time decoding step and at least one iteration, each iteration comprising the following sub-steps:

- diversity pre-decoding, which is the inverse of a diversity pre-encoding carried out when said signal is emitted, delivering pre-decoded data;
- estimation of the symbols forming said signal, from said pre-decoded data, delivering estimated symbols;
- diversity pre-encoding identical to said diversity pre-encoding implemented at emission, applied to said estimated symbols, to give an estimated signal, except for the last iteration.

2. Decoding method according to claim 1, characterized in that it comprises the following steps:

- space-time decoding, which is the inverse of the space-time encoding implemented at emission, delivering a decoded signal;
- equalization of said decoded signal, delivering an equalized signal;
- conversion of the matrix of the equalized signals into a diagonal matrix, obtained from a total encoding/channel/decoding matrix taking account of at least said encoding matrix, of a decoding matrix, corresponding to the matrix that is the conjugate transpose of said encoding matrix;
- diversity pre-decoding, which is the inverse of a diversity pre-encoding implemented at emission of said signal, delivering pre-decoded data;
- estimation of the symbols forming said signal, from said pre-decoded data, delivering estimated symbols;
- diversity pre-encoding, identical to said diversity pre-encoding implemented at emission, applied to said estimated symbols, to give an estimated signal;
- at least one iteration of an interference cancellation step implementing the following sub-steps:

- subtraction, from said equalized signal, of said estimated signal multiplied by an interference matrix, delivering an optimized signal ;
- diversity pre-decoding of said optimized signal, that is the inverse of a diversity pre-encoding implemented at emission of said signal, delivering pre-decoded data;
- estimation of the symbols forming said optimized signal, from pre-decoded data, delivering new estimated symbols;
- diversity pre-encoding identical to said diversity pre-encoding implemented at emission, applied to said new estimated symbols to give a new estimated signal, except for the last iteration.

3. A method according to claim 2, characterised in that said space-time decoding and equalization steps and/or said equalization and conversion steps are done jointly.

4. A decoding method according to any of the claims 1 to 3, characterized in that said encoded symbols being emitted by means of at least two antennas, the different corresponding transmission channels are taken comprehensively into account.

5. Decoding method according to any of the claims 2 to 4, characterized in that said equalization step implements an equalization according to one of the techniques belonging to the group comprising:

- MMSE type equalization;
- EGC type equalization;
- ZF type equalization;
- equalization taking account of a piece of information representing the signal-to-noise ratio between the received signal and the reception noise.

6. Decoding method according to any of the claims 2 to 5, characterized in that said steps of symbol estimation implement a soft decision, associating a piece of confidence information with a decision and in that said subtraction step or steps take account of said pieces of confidence information.

7. Decoding method according to any of the claims 2 to 5, characterized in that said received signal is a multicarrier signal.

8. A decoding method according to any of the claims 1 to 7, characterized in that said pre-encoding is obtained by one of the following methods:

- spread-spectrum techniques;
- linear pre-encoding.

9. A decoding method according to any of the claims 1 to 8, characterized in that it implements an automatic gain control step before or after said equalization step and/or during at least one of said iterations.

10. A decoding method according to any of the claims 1 to 9, characterized in that it comprises a channel-decoding step, symmetrical with a channel-encoding step implemented at emission.

11. A decoding method according to claim 10, characterized in that said channel-decoding step implements a turbo-decoding operation.

12. A decoding method according to any of the claims 1 to 11, characterized in that it comprises at least one de-interlacing step and at least one re-interlacing step, corresponding to an interlacing implemented at emission.

13. A decoding method according to any of the claims 1 to 12, characterized in that it comprises comprise a step of improvement of a channel estimation, taking account of the data estimated during at least one of said iterations.

14. A decoding method according to any of the claims 1 to 9, characterized in that, said received signal being transmitted by means of four antennas, said total matrix is equal to:

$$G = \gamma \begin{bmatrix} A & 0 & 0 & J \\ 0 & A & -J & 0 \\ 0 & -J & A & 0 \\ J & 0 & 0 & A \end{bmatrix}$$

with :

$$A = |h_1|^2 + |h_2|^2 + |h_3|^2 + |h_4|^2$$

$J = 2\mathrm{Re}\{h_1 h_4^* - h_2 h_3^*\}$, representing the interference, and

$$\gamma = \frac{1}{|h_1|^2 + |h_2|^2 + |h_3|^2 + |h_4|^2 + \frac{1}{SNR}}$$

where: $H = \begin{bmatrix} h_1 & h_2 & h_3 & h_4 \\ -h_2^* & h_1^* & -h_4^* & h_3^* \\ -h_3^* & -h_4^* & h_1^* & h_2^* \\ h_4 & -h_3 & -h_2 & h_1 \end{bmatrix}$ is a matrix grouping the space-time encoding and the transmission channel,

and SNR represents the signal-to-noise ratio.

15. A decoding method according to any of the claims 1 to 14, characterized in that, said received signal being transmitted by means of eight antennas, said total matrix is equal to:

$$G = \gamma \cdot H^H \cdot H = \gamma \begin{bmatrix} A & 0 & 0 & 0 & J & 0 & 0 & 0 \\ 0 & A & 0 & 0 & 0 & J & 0 & 0 \\ 0 & 0 & A & 0 & 0 & 0 & J & 0 \\ 0 & 0 & 0 & A & 0 & 0 & 0 & J \\ J & 0 & 0 & 0 & A & 0 & 0 & 0 \\ 0 & J & 0 & 0 & 0 & A & 0 & 0 \\ 0 & 0 & J & 0 & 0 & 0 & A & 0 \\ 0 & 0 & 0 & J & 0 & 0 & 0 & A \end{bmatrix}$$

with $A = |h_1|^2 + |h_2|^2 + |h_3|^2 + |h_4|^2 + |h_5|^2 + |h_6|^2 + |h_7|^2 + |h_8|^2$ and

$J = 2\mathrm{Im}\{h_1 h_5^* + h_2 h_6^* + h_3 h_7^* + h_4 h_8^*\}$

and $\gamma = \dfrac{1}{|h_1|^2 + |h_2|^2 + |h_3|^2 + |h_4|^2 + |h_5|^2 + |h_6|^2 + |h_7|^2 + |h_8|^2 + \frac{1}{SNR}}$

where : $$H=\begin{bmatrix} h_1 & h_2 & h_3 & h_4 & h_5 & h_6 & h_7 & h_8 \\ h_2 & -h_1 & h_4 & -h_3 & h_6 & -h_5 & h_8 & -h_7 \\ h_3 & -h_4 & -h_1 & h_2 & h_7 & -h_8 & -h_5 & h_6 \\ h_4 & h_3 & -h_2 & -h_1 & h_8 & h_7 & -h_6 & -h_5 \\ h_1^* & h_2^* & h_3^* & h_4^* & h_5^* & h_6^* & h_7^* & h_8^* \\ h_2^* & -h_1^* & h_4^* & -h_3^* & h_6^* & -h_5^* & h_8^* & -h_7^* \\ h_3^* & -h_4^* & -h_1^* & h_2^* & h_7^* & -h_8^* & -h_5^* & h_6^* \\ h_4^* & h_3^* & -h_2^* & -h_1^* & h_8^* & h_7^* & -h_6^* & -h_5^* \\ h_5 & h_6 & h_7 & h_8 & h_1 & h_2 & h_3 & h_4 \\ h_6 & -h_5 & h_8 & -h_7 & h_2 & -h_1 & h_4 & -h_3 \\ h_7 & -h_8 & -h_5 & h_6 & h_3 & -h_4 & -h_1 & h_2 \\ h_8 & h_7 & -h_6 & -h_5 & h_4 & h_3 & -h_2 & -h_1 \\ h_5^* & h_6^* & h_7^* & h_8^* & h_1^* & h_2^* & h_3^* & h_4^* \\ h_6^* & -h_5^* & h_8^* & -h_7^* & h_2^* & -h_1^* & h_4^* & -h_3^* \\ h_7^* & -h_8^* & -h_5^* & h_6^* & h_3^* & -h_4^* & -h_1^* & h_2^* \\ h_8^* & h_7^* & -h_6^* & -h_5^* & h_4^* & h_3^* & -h_2^* & -h_1^* \end{bmatrix},$$

is a matrix grouping the space-time encoding and the transmission channel

and SNR represents the signal-to-noise ratio.

16. Encoding and decoding method, characterized in that encoding implements a space-time encoding such that:

$$H=\begin{bmatrix}
h_1 & h_2 & h_3 & h_4 & h_5 & h_6 & h_7 & h_8\\
h_2 & -h_1 & h_4 & -h_3 & h_6 & -h_5 & h_8 & -h_7\\
h_3 & -h_4 & -h_1 & h_2 & h_7 & -h_8 & -h_5 & h_6\\
h_4 & h_3 & -h_2 & -h_1 & h_8 & h_7 & -h_6 & -h_5\\
h_1^* & h_2^* & h_3^* & h_4^* & h_5^* & h_6^* & h_7^* & h_8^*\\
h_2^* & -h_1^* & h_4^* & -h_3^* & h_6^* & -h_5^* & h_8^* & -h_7^*\\
h_3^* & -h_4^* & -h_1^* & h_2^* & h_7^* & -h_8^* & -h_5^* & h_6^*\\
h_4^* & h_3^* & -h_2^* & -h_1^* & h_8^* & h_7^* & -h_6^* & -h_5^*\\
h_5 & h_6 & h_7 & h_8 & h_1 & h_2 & h_3 & h_4\\
h_6 & -h_5 & h_8 & -h_7 & h_2 & -h_1 & h_4 & -h_3\\
h_7 & -h_8 & -h_5 & h_6 & h_3 & -h_4 & -h_1 & h_2\\
h_8 & h_7 & -h_6 & -h_5 & h_4 & h_3 & -h_2 & -h_1\\
h_5^* & h_6^* & h_7^* & h_8^* & h_1^* & h_2^* & h_3^* & h_4^*\\
h_6^* & -h_5^* & h_8^* & -h_7^* & h_2^* & -h_1^* & h_4^* & -h_3^*\\
h_7^* & -h_8^* & -h_5^* & h_6^* & h_3^* & -h_4^* & -h_1^* & h_2^*\\
h_8^* & h_7^* & -h_6^* & -h_5^* & h_4^* & h_3^* & -h_2^* & -h_1^*
\end{bmatrix},$$

and in that the decoding is a decoding according to claim 14.

17. Receiver implementing means for decoding a received signal, comprising symbols distributed in space and time and/or frequency by means of a space-time encoding matrix,

characterized in that it comprises means of space-time decoding that is the inverse of the space-time encoding implemented at emission, and:

- means of diversity pre-decoding of said optimized signal, performing a pre-decoding which is the inverse of a diversity pre-encoding carried out at emission of said signal, delivering pre-decoded data;
- means of estimation of the symbols forming said optimized signal, from pre-decoded data, delivering new estimated symbols;
- means of diversity pre-encoding, performing a pre-encoding identical to said diversity pre-encoding implemented at emission, applied to said new estimated symbols, to give a new estimated signal,

said means being implemented at least once for each symbol.

18. Method for the decoding of a received signal comprising symbols distributed in space, time and/or frequency by means of a space-time or space-

frequency encoding matrix,

characterized in that the method comprises the following steps:

- diagonalization, obtained from a total encoding/channel/decoding matrix taking account of at least said encoding matrix, of a decoding matrix, corresponding to the matrix that is the conjugate transpose of said encoding matrix;
- demodulation, symmetrical with a modulation implemented at emission;
- de-interlacing symmetrical with an interlacing implemented at emission;
- channel decoding symmetrical with a channel encoding implemented at emission;
- re-interlacing, identical with the one implemented at emission;
- re-modulation identical with the one implemented at emission, delivering an estimated signal;
- at least one iteration of an interference cancellation step comprising a subtraction from an equalized signal of said estimated signal multiplied by an interference matrix, delivering an optimized signal.